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From Spatial Clouds To Service Clouds: Integrating Saas-Driven Hospitality Platforms With Planetary-Scale Remote Sensing Infrastructures For Next-Generation Experience Design

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Abstract: The contemporary digital economy is witnessing two parallel yet historically disconnected revolutions: the maturation of cloud computing as a planetary-scale infrastructure for managing geospatial and remote sensing data, and the transformation of hospitality from a physical, location-bound service industry into a digitally mediated, experience-centric service ecosystem driven by Software-as-a-Service platforms. While these domains have developed largely in isolation, recent scholarly and industrial trends suggest a growing convergence, in which hospitality enterprises increasingly rely on geospatial intelligence, cloud-native analytics, and service-oriented architectures to personalize, optimize, and dynamically orchestrate guest experiences. This article advances an integrated theoretical and methodological framework that situates SaaS-driven hospitality within the broader evolution of spatial cloud computing and Earth observation platforms, arguing that hospitality experience design has become inseparable from the same cloud infrastructures that support planetary-scale environmental analytics. Building upon the hospitality-focused SaaS paradigm articulated by Goel (2025), alongside foundational and contemporary scholarship on cloud computing, geoprocessing, and big Earth observation data, the study conceptualizes hospitality platforms as service clouds that draw upon distributed data layers, including remote sensing, location-based services, and real-time environmental intelligence. Through an extensive synthesis of literature on Infrastructure-as-a-Service, Platform-as-a-Service, Software-as-a-Service, spatial data cubes, and cloud-based remote sensing analytics, the article demonstrates how experience-centric hospitality applications are increasingly embedded in the same elastic, containerized, and API-driven architectures that support global Earth observation ecosystems. Methodologically, the research adopts a qualitative, theory-building approach grounded in comparative platform analysis, interpretive reading of technical architectures, and cross-domain synthesis, allowing for a deep interrogation of how hospitality SaaS platforms reconfigure traditional service logics through cloud-native affordances. The results reveal that hospitality SaaS systems now function as dynamic orchestration layers that translate geospatial, behavioral, and environmental data into actionable, real-time service personalization, thereby extending the notion of service quality beyond interpersonal interactions into algorithmically mediated experience ecologies. The discussion situates these findings within broader debates on digital transformation, data sovereignty, scalability, and the political economy of cloud infrastructures, highlighting both the emancipatory potential of SaaS-enabled experience design and the structural dependencies it creates on planetary-scale cloud providers. Ultimately, the article argues that the future of hospitality lies not merely in digital interfaces but in the deep integration of service platforms with the spatial and computational substrates of the cloud, marking a decisive shift from concierge-based service delivery to cloud-orchestrated experience ecosystems.

Keywords: Cloud computing, Software-as-a-Service, hospitality platforms, spatial cloud computing, remote sensing, experience design.

INTRODUCTION:

The evolution of cloud computing has fundamentally reshaped how data, services, and computational resources are produced, distributed, and consumed across virtually every sector of the global economy, a transformation that has been extensively theorized since the early conceptualizations of on-demand computing and virtualized infrastructures articulated by Bechtolsheim (2008) and Mell and Grance (2009). Within this broader technological trajectory, hospitality has historically been viewed as a predominantly physical and interpersonal industry, grounded in face-to-face service encounters, localized infrastructure, and the embodied presence of guests and staff. Yet recent scholarship suggests that this characterization is increasingly inadequate, as hospitality enterprises are now deeply embedded in cloud-native ecosystems that mediate booking, personalization, operations, and even the spatial and environmental contexts of guest experiences (Goel, 2025). The shift from concierge-driven to cloud-orchestrated service delivery is not merely a technological upgrade but a structural reconfiguration of how hospitality value is created, distributed, and experienced, situating hotels, resorts, and travel platforms within the same planetary-scale digital infrastructures that support scientific, governmental, and commercial data processing.

Parallel to the digital transformation of hospitality, the field of remote sensing and Earth observation has undergone its own radical reorganization through the emergence of spatial cloud computing platforms, such as Google Earth Engine and other geoprocessing clouds that enable massive, distributed analysis of satellite imagery and environmental data (Amani et al., 2020; Yang and Huang, 2014). These platforms have made it possible to analyze global datasets in near real time, collapsing traditional barriers of data storage, computation, and access, and enabling new forms of knowledge production that operate at planetary scale (Gomes et al., 2020; Kopp et al., 2019). Although hospitality and remote sensing may appear to occupy distinct epistemic and economic domains, both are increasingly dependent on the same underlying cloud architectures, service models, and data pipelines, suggesting the need for a unified analytical framework that can account for their convergence.

The theoretical foundations of cloud computing, as articulated in the NIST definition, emphasize five essential characteristics, including on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service, alongside three primary service models: Infrastructure-as-a-Service, Platform-as-a-Service, and Software-as-a-Service (Mell and Grance, 2009). These abstractions were initially developed to describe enterprise computing and scientific workloads, yet they have become equally central to consumer-facing digital platforms, including those that mediate hospitality experiences. In this respect, Goel's (2025) analysis of SaaS-driven hospitality can be read as an extension of classical cloud theory into the domain of experiential services, where the software layer becomes the primary interface through which guests encounter and co-produce value.

At the same time, the rise of cloud-based remote sensing has demonstrated that Software-as-a-Service is not limited to transactional or administrative functions but can serve as a powerful medium for delivering complex analytical capabilities to end users, including scientists, policymakers, and increasingly, commercial actors in sectors such as tourism and hospitality (Wang et al., 2013; Yan et al., 2018). Platforms such as Google Earth Engine provide web-based interfaces that abstract away the complexity of satellite data processing, allowing users to access, visualize, and analyze geospatial information through high-level APIs and scripting environments (Amani et al., 2020). This same logic of abstraction, modularization, and service orientation underpins hospitality SaaS platforms, which encapsulate reservation systems, customer relationship management, dynamic pricing, and personalized recommendation engines into cloud-hosted services that can be accessed from anywhere (Goel, 2025).

Despite these parallels, existing literature has largely treated hospitality SaaS and spatial cloud computing as separate research traditions, with limited dialogue between scholars of service management and those

of geospatial informatics. This fragmentation constitutes a significant gap, given that modern hospitality experiences are increasingly shaped by spatial and environmental data, including weather forecasts, mobility patterns, land-use dynamics, and even ecological conditions that influence destination attractiveness (Hausner et al., 2018; Yang et al., 2019). Cloud-based platforms make it possible to integrate these data streams into hospitality applications, enabling real-time adaptation of services to environmental and spatial contexts, yet the theoretical implications of this integration remain underexplored.

The literature on cloud service models provides an important starting point for addressing this gap, as it clarifies how different layers of the cloud stack enable distinct forms of innovation and value creation (BluePiIT, 2021; RubyGarage, 2021). Infrastructure-as-a-Service provides the raw computational and storage resources needed to host large datasets and scalable applications, Platform-as-a-Service offers development and deployment environments for building cloud-native software, and Software-as-a-Service delivers end-user applications that encapsulate complex functionalities behind intuitive interfaces. In remote sensing, this stack has enabled the creation of data cubes, containerized analytics engines, and API-driven workflows that allow for flexible, scalable, and interoperable geoprocessing (Schramm et al., 2021; Huang et al., 2021). In hospitality, the same stack supports booking engines, property management systems, and experience orchestration platforms that can be continuously updated and scaled across global markets (Goel, 2025).

Historically, hospitality technology was dominated by on-premise systems and proprietary software, which limited interoperability, scalability, and the ability to integrate external data sources. The move to cloud-based SaaS has dismantled many of these constraints, allowing hospitality firms to tap into a global ecosystem of third-party services, including geolocation, mapping, and environmental analytics (Goel, 2025). This shift mirrors the trajectory of remote sensing, where the migration of satellite archives to cloud platforms such as those managed by USGS and commercial providers has dramatically increased accessibility and analytical power (Kline, 2021). Both sectors thus exemplify a broader trend toward the platformization of data and services, in which value is generated through the orchestration of distributed resources rather than through ownership of physical assets.

The theoretical implications of this convergence are profound, as they challenge traditional distinctions between front-stage and back-stage operations in hospitality, as well as between data production and data consumption in geospatial science. In a cloud-native environment, the same APIs and data pipelines that feed scientific models can also inform customer-facing applications, blurring the boundary between analytical infrastructure and experiential interface (Yue et al., 2013; Goel, 2025). For example, a resort management system might draw upon cloud-hosted weather and satellite data to adjust outdoor activity schedules, energy usage, and even marketing messages in real time, creating a tightly coupled feedback loop between environmental conditions and service delivery (Hausner et al., 2018).

This article argues that understanding this emerging reality requires a reconceptualization of hospitality not merely as a service industry but as a node within a planetary-scale computational ecology, in which experiences are co-produced by human actors and cloud-based systems that process vast amounts of spatial, behavioral, and environmental data. By synthesizing the hospitality-focused SaaS paradigm articulated by Goel (2025) with the extensive literature on spatial cloud computing and Earth observation platforms (Amani et al., 2020; Yang and Huang, 2014; Gomes et al., 2020), the study seeks to articulate a unified framework for analyzing how cloud infrastructures mediate contemporary hospitality experiences.

Such a framework is also necessary to address the political and ethical dimensions of cloud-based service ecosystems, including issues of data sovereignty, platform dependency, and the uneven distribution of computational power. Scholars of cloud computing have long noted that while cloud architectures promise democratization of access to

computing resources, they also concentrate control in the hands of a few large providers who operate the underlying infrastructures (Foster et al., 2008; Rimal et al., 2009). In the context of hospitality, this concentration has implications for how guest data, location information, and behavioral profiles are collected, processed, and monetized, raising questions about privacy, surveillance, and the commodification of experience (Goel, 2025).

The literature on model-driven architecture and service-oriented design further complicates this picture by emphasizing the role of abstraction and standardization in enabling interoperability across heterogeneous systems (Kleppe et al., 2003; Miller and Mukerji, 2003; Sharma and Sood, 2011). In both remote sensing and hospitality, APIs and standardized data models allow different platforms to exchange information and coordinate actions, yet they also impose particular logics of representation and control that shape how reality is rendered in digital form. For example, the openEO API seeks to harmonize access to Earth observation data across multiple cloud providers, promoting portability and reproducibility in geospatial analytics (Schramm et al., 2021). Similarly, hospitality SaaS platforms often rely on standardized interfaces to integrate booking channels, payment systems, and third-party services, creating a modular yet tightly coupled ecosystem (Goel, 2025).

The problem that emerges from this complex landscape is not merely technical but epistemological and organizational: how can hospitality enterprises meaningfully integrate the immense analytical capabilities of spatial cloud computing into their service designs without becoming overly dependent on opaque and centralized platforms? Existing research has provided detailed accounts of cloud-based geoprocessing architectures (Yao et al., 2020; Huang et al., 2021) and of SaaS-driven hospitality transformations (Goel, 2025), yet there remains a lack of integrative theory that explains how these domains intersect and co-evolve.

This article addresses that gap by advancing a cross-disciplinary analysis that treats hospitality SaaS platforms as a specific instantiation of the broader cloud computing paradigm that also underpins remote sensing and Earth observation. By doing so, it aims to illuminate how the same principles of elasticity, virtualization, and service orientation that enable planetary-scale environmental analytics also enable hyper-personalized, data-driven hospitality experiences. The introduction thus sets the stage for a methodological and analytical exploration of this convergence, situating it within the historical development of cloud computing and the contemporary dynamics of digital service industries (Bechtolsheim, 2008; Mell and Grance, 2009; Goel, 2025).

METHODOLOGY

The methodological orientation of this study is grounded in qualitative, theory-building research that seeks to synthesize and reinterpret existing bodies of literature rather than to generate primary empirical data, a choice that is particularly appropriate given the infrastructural and cross-sectoral nature of the phenomena under investigation (Foster et al., 2008; Yang and Huang, 2014). Cloud computing, remote sensing platforms, and hospitality SaaS systems are not easily reducible to discrete variables or controlled experiments, as they operate as complex socio-technical assemblages that evolve over time through interactions among technologies, organizations, and regulatory environments (Rimal et al., 2009; Goel, 2025). Consequently, the methodology adopted here emphasizes interpretive analysis, comparative reading, and conceptual integration as tools for generating new theoretical insights.

The primary corpus of analysis consists of the scholarly and technical sources provided in the reference list, including foundational works on cloud computing definitions and architectures (Mell and Grance, 2009; Bechtolsheim, 2008), surveys and taxonomies of cloud systems (Rimal et al., 2009), literature on model-driven and service-oriented architectures (Kleppe et al., 2003; Sharma and Sood, 2011), and extensive research on cloud-based remote sensing and Earth observation platforms (Amani et al., 2020; Gomes et al., 2020; Schramm et al., 2021). These sources are read alongside the hospitality-focused SaaS analysis developed by Goel (2025),

which serves as a conceptual anchor for understanding how cloud computing principles are instantiated in experiential service industries.

The analytical process involves several iterative stages. First, key theoretical constructs are identified within each domain, including service models, platform architectures, data abstractions, and modes of user interaction, drawing on the comparative frameworks proposed by Foster et al. (2008) and Yue et al. (2013). In the context of remote sensing, this includes concepts such as data cubes, geoprocessing workflows, and elastic computing paradigms, while in hospitality SaaS it includes notions of experience orchestration, personalization engines, and cloud-based service delivery (Huang et al., 2021; Goel, 2025). These constructs are then mapped onto one another to identify structural and functional correspondences, revealing how similar architectural logics operate across ostensibly different application domains.

Second, the study employs a form of qualitative comparative analysis that examines how different cloud service models are used in remote sensing and hospitality, using descriptive accounts from sources such as BluePilT (2021) and RubyGarage (2021) to clarify the technical and organizational implications of IaaS, PaaS, and SaaS. This comparison allows for an exploration of how hospitality platforms, like Earth observation platforms, rely on layered cloud architectures to deliver complex services to end users, and how these layers mediate issues of scalability, interoperability, and control (Gomes et al., 2020; Goel, 2025).

Third, the methodology incorporates a critical reading of case-based and application-oriented studies in cloud-based remote sensing, such as those examining Landsat data processing, forest biomass estimation, and land-cover mapping (Hausner et al., 2018; Yang et al., 2019; Shaharum et al., 2019), to understand how spatial and environmental data are operationalized through cloud platforms. These insights are then extrapolated to the hospitality context, where similar data streams can inform location-aware, environmentally responsive service designs, a linkage that is conceptually grounded in Goel's (2025) argument that hospitality SaaS platforms increasingly integrate diverse data sources to create adaptive experiences.

The methodological rationale for this integrative approach is rooted in the recognition that cloud computing functions as a general-purpose infrastructure that underlies multiple domains of application, making cross-domain comparison both possible and necessary (Mell and Grance, 2009; Foster et al., 2008). By treating hospitality SaaS and spatial cloud computing as different expressions of the same infrastructural paradigm, the study seeks to uncover deep structural similarities that might otherwise remain obscured by disciplinary boundaries (Yang and Huang, 2014; Goel, 2025).

Nevertheless, this methodology also has limitations, which are acknowledged as part of the analytical rigor of the study. The reliance on secondary literature means that the findings are necessarily mediated by the perspectives and contexts of the original authors, potentially limiting the ability to capture the most recent industrial developments or proprietary implementations of cloud-based hospitality systems (Amani et al., 2020; Goel, 2025). Furthermore, the absence of primary empirical data restricts the capacity to test hypotheses about causal relationships between cloud architectures and hospitality outcomes, positioning the study as a theoretical and conceptual contribution rather than a predictive or evaluative one (Rimal et al., 2009; Yue et al., 2013).

Despite these limitations, the methodological design is well suited to the exploratory and integrative aims of the research, as it allows for a comprehensive synthesis of diverse literatures and the construction of a new conceptual framework that bridges service management and geospatial informatics. By grounding this synthesis in authoritative and peer-reviewed sources across both domains, the study ensures that its theoretical claims are anchored in established scholarship while also pushing beyond existing boundaries to propose novel interpretations of cloud-driven hospitality (Goel, 2025; Gomes et al., 2020).

RESULTS

The integrative analysis undertaken in this study yields several interrelated findings that collectively illuminate how SaaS-driven hospitality platforms and spatial cloud computing infrastructures converge to form a unified ecosystem of cloud-mediated experience design, a conclusion that resonates strongly with Goel's (2025) portrayal of hospitality as an increasingly software-defined industry. One of the most significant results is the identification of a shared architectural logic between hospitality SaaS systems and Earth observation platforms, in which both rely on layered cloud service models to abstract complexity and deliver high-level functionalities to end users (Mell and Grance, 2009; Amani et al., 2020). This shared logic manifests in the way hospitality applications encapsulate diverse data sources, computational processes, and user interactions into coherent service interfaces, much as geospatial platforms encapsulate satellite imagery, analytical algorithms, and visualization tools into web-based environments (Gomes et al., 2020; Goel, 2025).

Another key finding is that the data pipelines underlying modern hospitality SaaS platforms increasingly mirror those used in remote sensing and spatial analytics, particularly in their reliance on distributed storage, parallel processing, and API-driven interoperability (Yan et al., 2018; Schramm et al., 2021). For instance, just as Google Earth Engine allows researchers to query and process petabytes of satellite data through high-level scripting interfaces (Amani et al., 2020), hospitality SaaS platforms allow operators and guests to interact with vast repositories of behavioral, transactional, and contextual data through dashboards and mobile applications that hide the underlying computational complexity (Goel, 2025). This convergence suggests that hospitality experience design is no longer limited by the physical boundaries of a property but is instead shaped by the same elastic and scalable infrastructures that support global scientific research.

The results also reveal that spatial and environmental data, traditionally associated with remote sensing and Earth observation, are becoming integral components of hospitality SaaS ecosystems, enabling a new generation of location-aware and environmentally responsive services (Hausner et al., 2018; Yang et al., 2019). By integrating weather data, land-use information, and mobility patterns into their platforms, hospitality providers can dynamically adjust pricing, staffing, and activity offerings in ways that were previously impossible with on-premise systems (Goel, 2025). This finding underscores the practical significance of the theoretical convergence identified in the literature, demonstrating that the integration of spatial cloud computing into hospitality SaaS is not merely conceptual but operational.

A further result concerns the role of standardization and APIs in enabling this integration, as both remote sensing platforms and hospitality SaaS systems depend on well-defined interfaces to connect disparate services and data sources (Schramm et al., 2021; Sharma and Sood, 2011). The openEO API, for example, seeks to harmonize access to Earth observation data across multiple cloud providers, facilitating portability and interoperability (Schramm et al., 2021), while hospitality platforms similarly rely on standardized interfaces to integrate booking engines, payment gateways, and third-party experience providers (Goel, 2025). This parallel highlights the importance of model-driven and service-oriented architectures in creating flexible and extensible cloud ecosystems across domains (Kleppe et al., 2003; Miller and Mukerji, 2003).

Collectively, these results point to a broader reconfiguration of hospitality as a data-intensive, cloud-native industry whose core competencies increasingly lie in the ability to orchestrate distributed services and data streams rather than in the management of physical assets alone, a conclusion that aligns with Goel's (2025) argument that the future of hospitality is fundamentally SaaS-driven.

DISCUSSION

The findings of this study invite a deeper theoretical interpretation that situates SaaS-driven hospitality within the long-standing scholarly debates on cloud computing, service orientation, and the socio-technical dynamics of digital platforms, debates that have been shaped by foundational works such as

those of Mell and Grance (2009) and Foster et al. (2008) and extended into contemporary analyses of spatial cloud computing and Earth observation (Amani et al., 2020; Gomes et al., 2020). One of the central implications of the results is that hospitality, traditionally conceptualized as an embodied and place-based service, has become an instantiation of what might be called a service cloud, in which experiences are assembled through the orchestration of software modules, data flows, and computational resources that exist largely outside the physical premises of a hotel or resort (Goel, 2025).

From a theoretical perspective, this shift can be understood through the lens of service-dominant logic, which emphasizes that value is co-created through interactions among actors, resources, and institutional arrangements rather than embedded in tangible goods. Cloud computing extends this logic by providing a flexible and scalable substrate on which such interactions can be continuously reconfigured (Rimal et al., 2009; Goel, 2025). In the context of hospitality, SaaS platforms become the primary mediators of value co-creation, enabling guests, staff, and external service providers to interact within a shared digital environment that integrates booking, communication, personalization, and feedback mechanisms. This environment is structurally analogous to the cloud-based platforms used in remote sensing, where scientists, data providers, and analytical tools converge within a unified computational space (Yang and Huang, 2014; Amani et al., 2020).

The integration of spatial and environmental data into hospitality SaaS platforms further complicates traditional service theories by introducing non-human actors, such as satellites, sensors, and algorithms, into the process of experience co-creation (Huang et al., 2021; Goel, 2025). These actors generate and process information that shapes service outcomes, from the scheduling of outdoor activities based on weather forecasts to the optimization of energy usage based on occupancy patterns. In this sense, hospitality experiences are no longer solely the product of human intention and interaction but are also the emergent outcome of complex computational processes that operate across multiple scales of time and space, a dynamic that mirrors the algorithmic mediation of knowledge in cloud-based Earth observation (Gomes et al., 2020; Yao et al., 2020).

Scholarly debates on the political economy of cloud computing provide a critical lens through which to assess these developments, particularly with regard to issues of dependency, control, and data governance (Foster et al., 2008; Rimal et al., 2009). While SaaS-driven hospitality platforms promise greater efficiency, personalization, and innovation, they also tie hospitality providers and guests to the infrastructures and policies of a relatively small number of global cloud providers, raising concerns about vendor lock-in, data privacy, and the commodification of personal and spatial information (Goel, 2025). Similar concerns have been raised in the context of remote sensing, where the migration of satellite archives to commercial cloud platforms has created new dependencies and potential barriers to open scientific inquiry (Kline, 2021; Amani et al., 2020).

The role of standardization and open APIs emerges as a potential counterbalance to these tendencies, as they enable interoperability and portability across platforms, reducing the risk of monopolistic control (Schramm et al., 2021; Sharma and Sood, 2011). However, standardization also imposes particular epistemic and operational frameworks that shape how data and services are represented and accessed, potentially constraining alternative forms of innovation. In hospitality, standardized data models and interfaces may privilege certain types of experiences and business models over others, embedding the priorities of platform providers into the very architecture of service delivery (Goel, 2025; Kleppe et al., 2003).

Looking forward, the convergence of hospitality SaaS and spatial cloud computing opens up new avenues for research and practice, including the development of context-aware, sustainable, and resilient tourism systems that can respond dynamically to environmental change and social dynamics (Hausner et al., 2018; Yang et al., 2019). At the same time, it demands a critical engagement with the ethical and

governance challenges posed by the pervasive collection and processing of data, challenges that are as relevant to a hotel booking platform as they are to a global Earth observation system (Amani et al., 2020; Goel, 2025).

CONCLUSION

The analysis presented in this article demonstrates that the digital transformation of hospitality through SaaS-driven platforms is deeply intertwined with the broader evolution of cloud computing and spatial data infrastructures, a convergence that redefines what it means to design and deliver experiences in a data-rich, cloud-native world (Goel, 2025; Mell and Grance, 2009). By situating hospitality within the same planetary-scale computational ecology that supports remote sensing and Earth observation, the study provides a new conceptual lens for understanding how services are orchestrated, personalized, and scaled in the twenty-first century. This perspective not only enriches theoretical debates on service management and cloud computing but also highlights the practical and ethical stakes of building hospitality systems on top of global cloud platforms.

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